

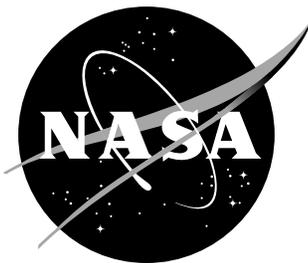


Lunar Applications in Reconfigurable Computing

MAPLD

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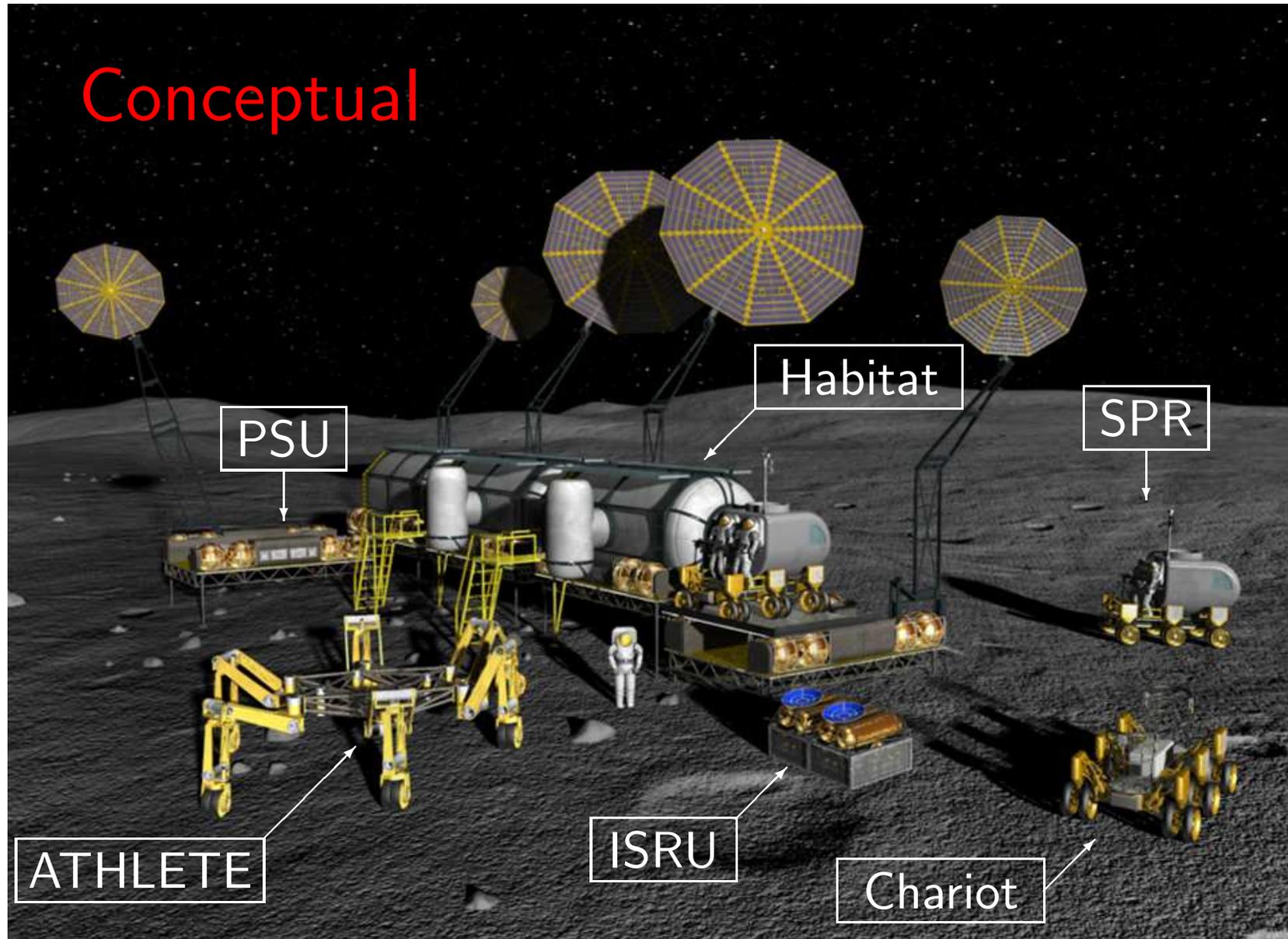
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Elements of a Conceptual Outpost



Benefits of Reconfigurable Computing

- Reduced mass from reuse of resources for multiple purposes dependent on context, single chip, potentially unrelated, multi-function device functions managed in a single device
- Power reduction (→ reduced mass) through technology advances, chip level integration, optimized efficiency for special purpose applications
- Commonality (→ reduced spares → reduced mass) inherent in the reuse of reconfigurable assets deployed across the surface architecture
- Flexibility
- Performance (→ power reduction → reduced mass)
- Cost reduction from ASIC development capabilities and performance within board level DDT&E budget

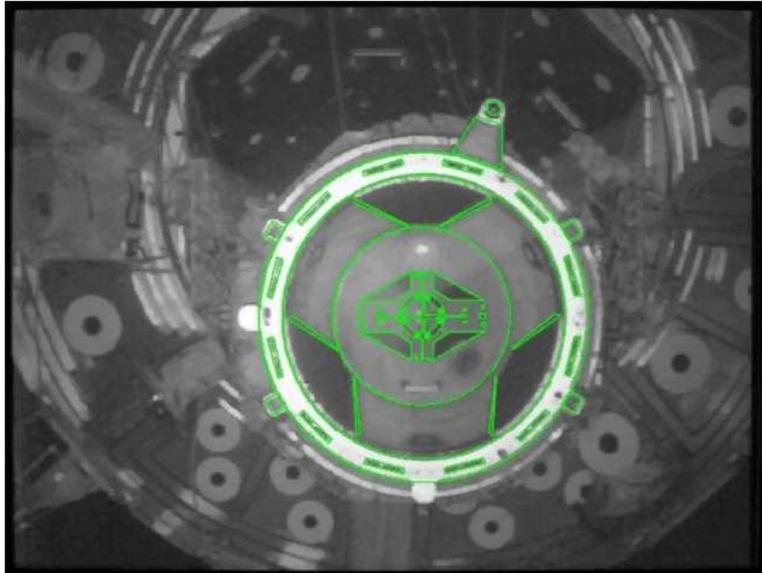
Video Processing Unit

- Responsible for processing and management of onboard video streams
- Video encoding, compression, and decoding in formats such as MPEG H.264
- Centralized Video Processing Unit (VPU) enables
 - Feature recognition, image enhancement such as edge detection and highlighting,
 - Sensor fusion of visible and non-visible spectrum imaging for synthetic illumination and feature detection
 - Video display augmentation to support crew observation and supervision

Communications

- Waveforming and encoding for Software Defined Radio (SDR) and basestation processing
- Compression and framing of telemetry data
- IP offloading as co-processor
- Potentially support network routing functions with embedded soft or hard processors

Advanced Instruments



Natural Feature Image Recognition (NFIR) Autonomous Rendezvous and Docking (AR&D) – The display shows an example of feature recognition based on a *a priori* knowledge (CAD model) of target. Uses a VPU processing visible imagery for massless capability providing autonomous dock.



Autonomous Landing and Hazard Avoidance Technology (ALHAT) Crew camera view of landing site. Input sensor data used for surface terrain relative and hazard relative navigation. In the lower figure, ALHAT data is overlaid on landing camera video highlighting hazards in red and optimal landing sites with blue circles.

System Health Management and Diagnostics

- Health data formatting and framing
- Data acquisition control using either embedded processors or state machine (flexibility in development and performance)
- In system debugging for system maintenance and repair
- Embedded protocol analysis via bus monitoring and protocol analysis
- Fault injection to verify fault detection and isolation capabilities in the host system
- Synthetic Instruments for automatic test systems utilizing Programmable Logic Device (PLD) and signal conditioning in system test and evaluation

Asset Management

- Goal of *context driven functionality* treating applications similar to software libraries
- Require capability to manage the use and configuration of the resources in a *safe, verifiable, and traceable manner*
- Discovery or determination of available reconfigurable assets using *publish-and-subscribe* architecture for identification of capabilities and properties
- Suitable application images, accessed through central network attached storage, must be located and also deployed to the selected assets along the datapath
- Verify correct deployment (correct image loaded to the reconfigurable hardware) as well as the interfaces to the applications

Conclusions

- Overview of a conceptual outpost
- Reviewed the benefits of reconfigurable computing
 - Video processing unit
 - Communications
 - Advanced instruments
 - Systems health monitoring and Diagnostics
- Several applications or application areas presented
- Considerations for asset management